Projected Changes in California's Forests due to Climate Change

Rebecca Shaw and co-authors

Presented by Dick Cameron, Senior Conservation Planner, The Nature Conservancy California Program

ARB Forest Inventory Symposium

October 19, 2009

The Nature Conservancy
Protecting nature. Preserving life.

Outline

Project overview

Methods and approach

Results for forest extent and carbon stocks

Implications for forest inventory and monitoring

Project Overview

- Part of CEC-PIER studies for Climate Action Team report to Governor and Legislature, 2009; *The Impact of Climate Change on California's Ecosystem Services,* R. Shaw et al.

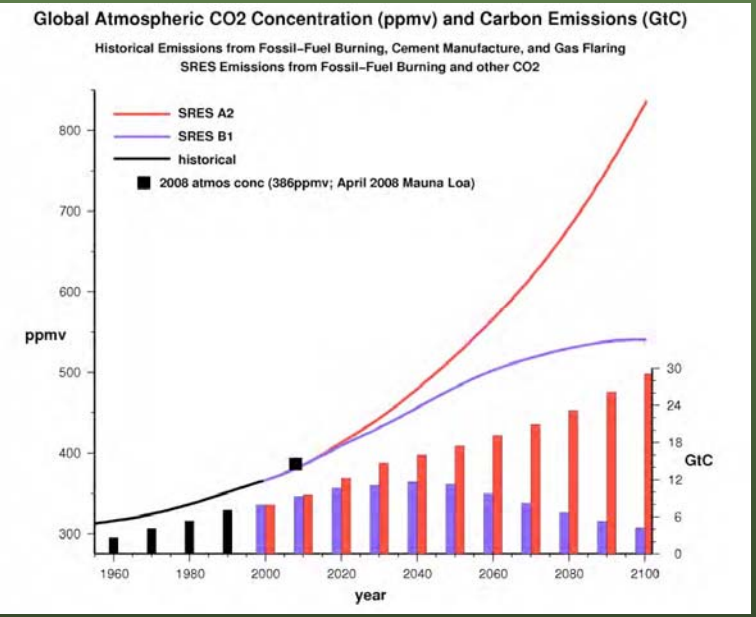
- Looked at changes in multiple services under three AOGCMs and two emissions scenarios (A2, B1) and economic implications of changes

- Services included forest carbon, forage production, freshwater for salmon fishery and snow recreation; and biodiversity

The Nature Conservancy
Protecting nature. Preserving life.

Climate Models and Emissions Scenarios

- Chose a range of models that perform well in CA and that bracket potential future climate



Cayan et al. 2009

- Warm, wet climate- NCAR-PCM1 (Washington et al. 2000)

- Hot, dry climate- GFDL-CM2.1 (Delworth et al 2006), NCAR-CCSM3 (Collins et al 2006)

- A2 (business as usual) and B1 (very optimistic) emissions scenarios to 2100

The Nature Conservancy
Protecting nature. Preserving life.

Vegetation and Carbon Model

- MC1 Dynamic Global Vegetation Model (DGVM) (Bachelet et al 2001) combination of MAPPS biogeography model (Neilson 1995) and CENTURY (Parton et al. 1994) biogeochemistry model

- Uses soil characteristics, climate data and reference data on nutrient cycling, fire, plant growth and decomposition to model coarse vegetation types and associated productivity, carbon pools, and fire frequency

Vegetation and Carbon Model, cont.

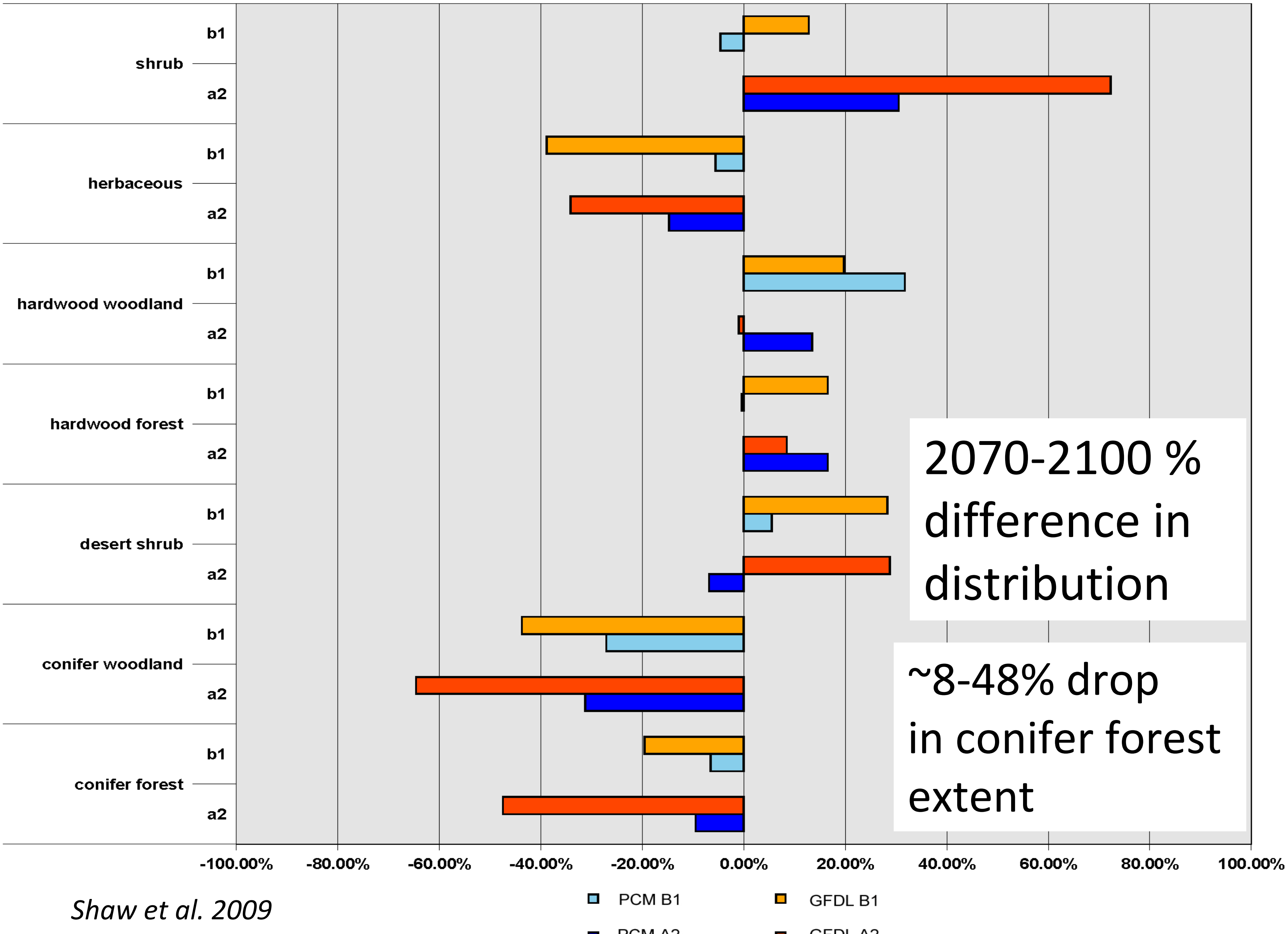
- 1/8 degree grid cells (~12.5 km)

- Fire model periodically consumes biomass when fuel and climate factors are conducive

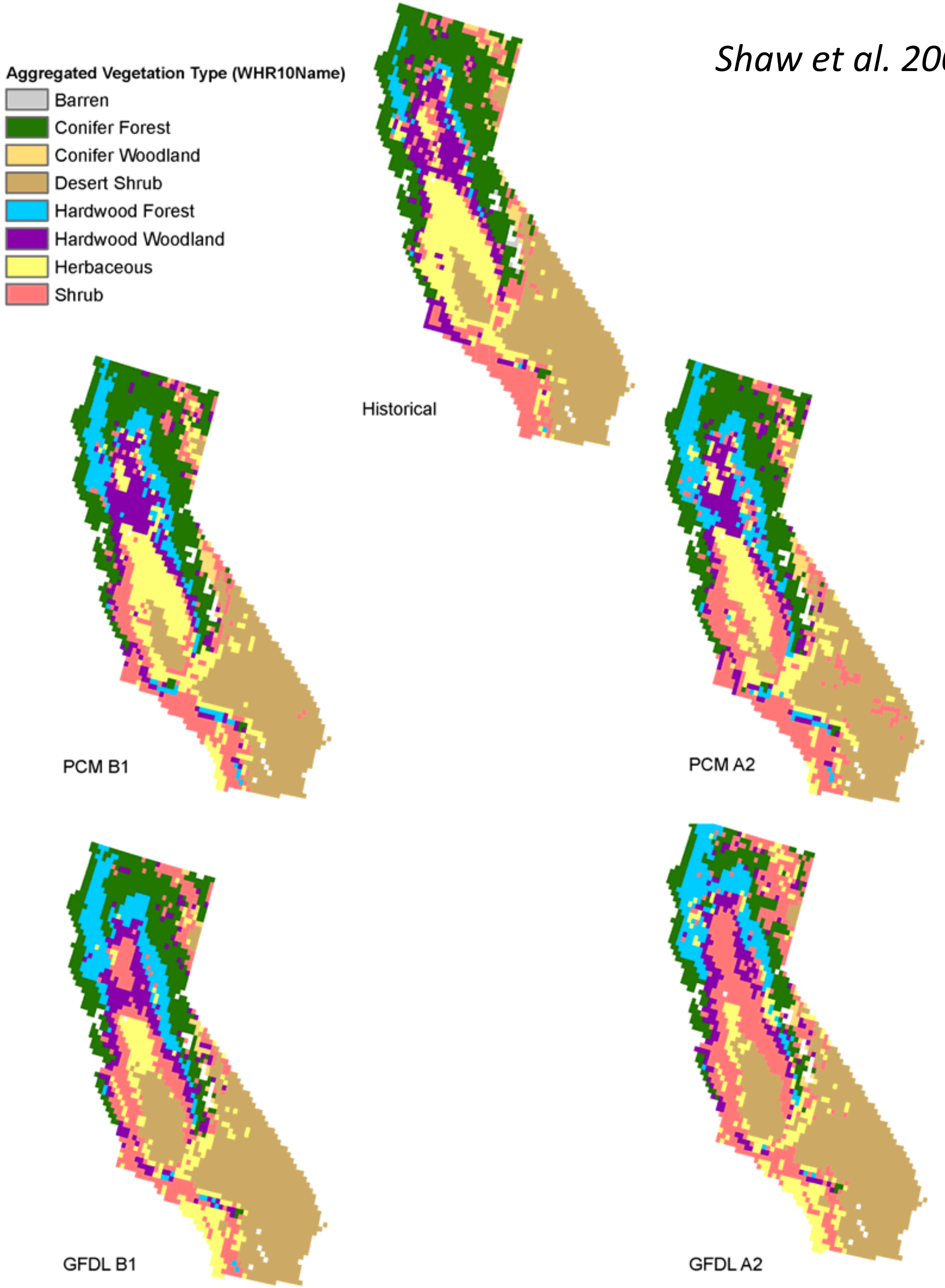
- Six carbon pools modeled (ag/bg live woody, ag/bg live grass, soil, ag dead)

- Various attributes summarized within 30 yr averages- *(2005 – 2034; 2035 – 2064; 2070 – 2100)*

The Nature Conservancy
Protecting nature. Preserving life.



Shaw et al. 2009

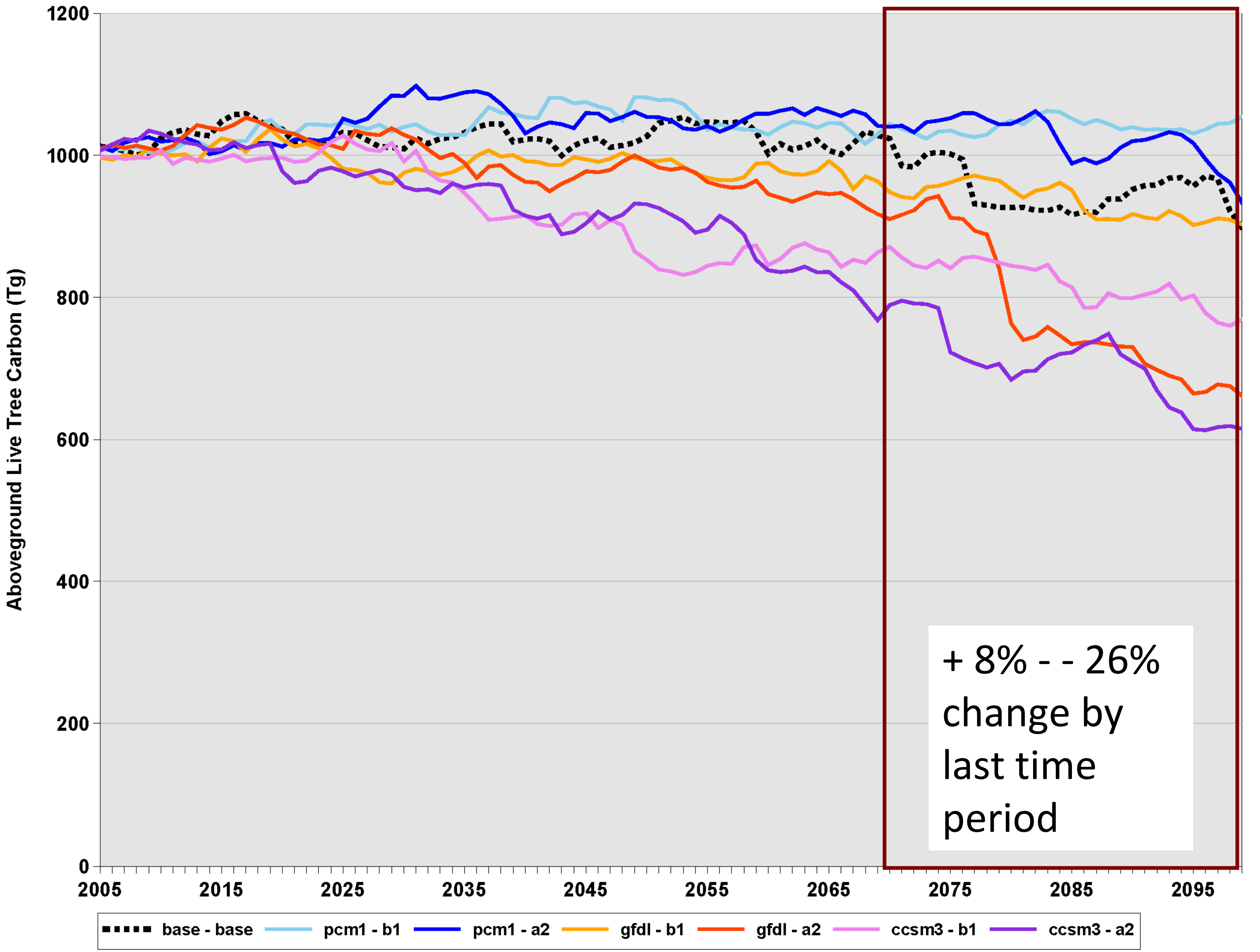


Shaw et al. 2009

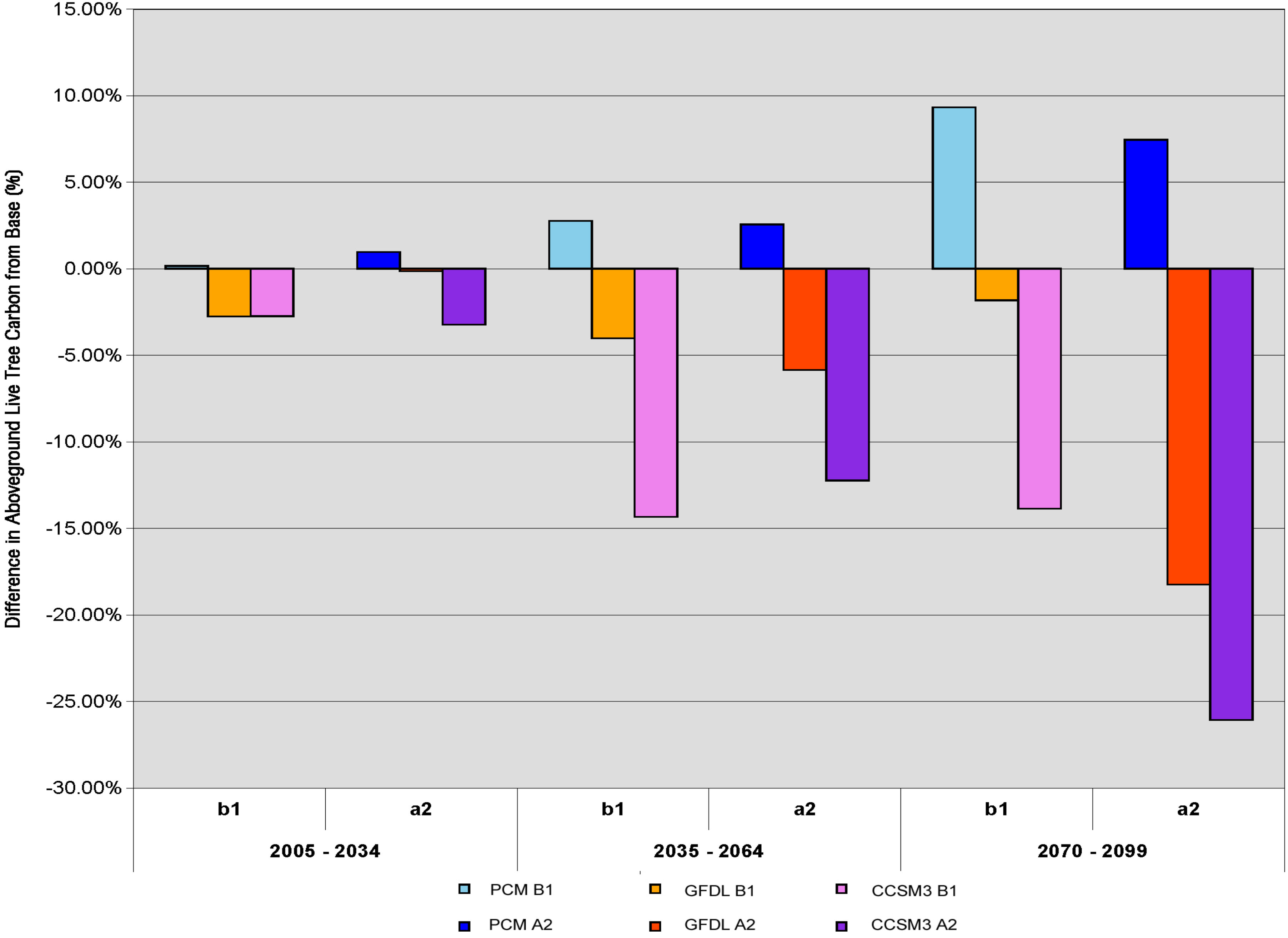
2070-2100 difference in distribution

Large increase in shrublands, hardwood forest

The Nature Conservancy
Protecting nature. Preserving life.

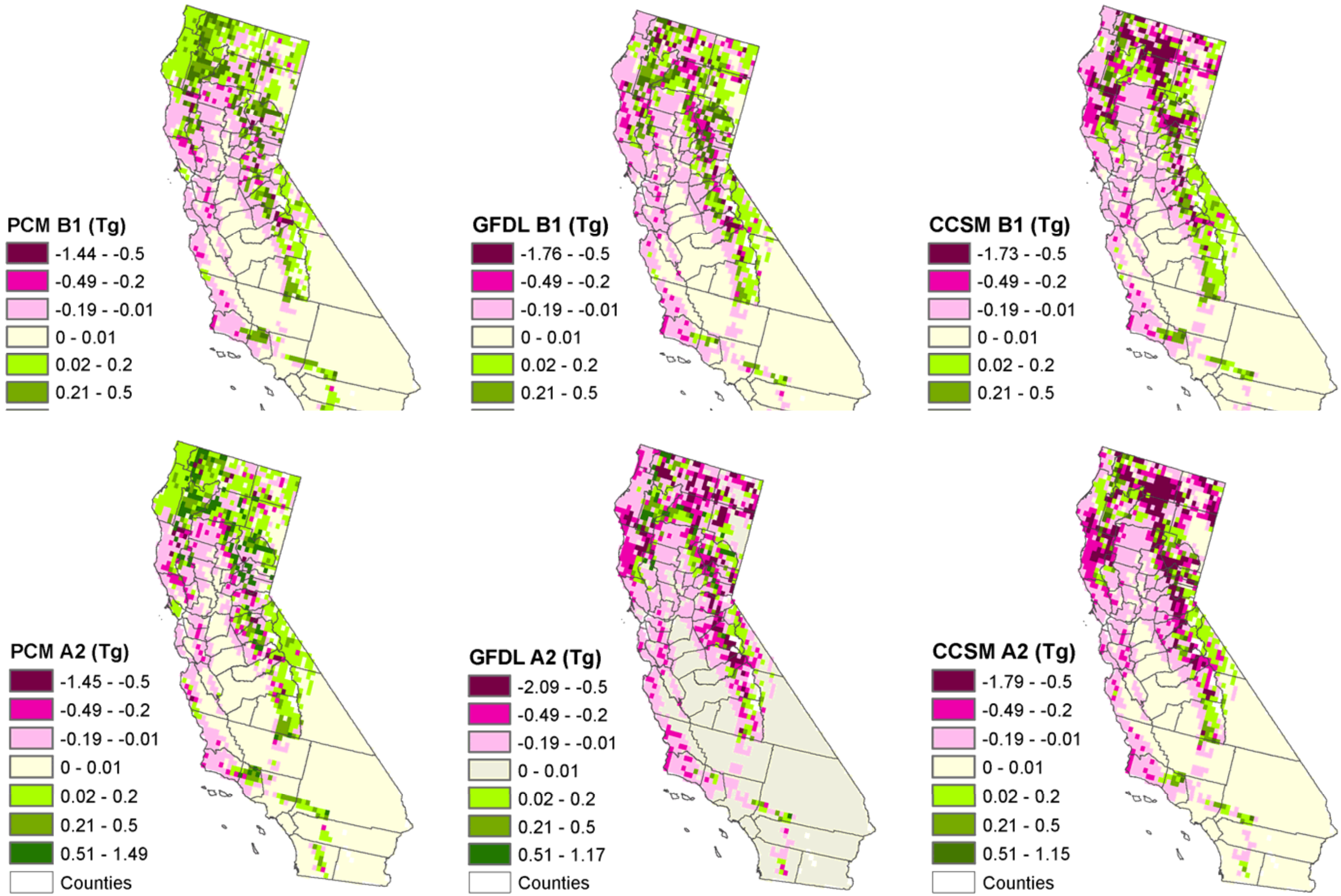


Aboveground Live Tree Carbon (Tg)
1200
1000
800
600
400
200
0
2005
2015
2025
2035
2045
2055
2065
2075
2085
2095
+ 8% - - 26% change by last time period
base - base
pcm1 - b1
pcm1 - a2
gfdl - b1
gfdl - a2
ccsm3 - b1
ccsm3 - a2



Difference in Aboveground Live Tree Carbon from Base (%)
15.00%
10.00%
5.00%
0.00%
-5.00%
-10.00%
-15.00%
-20.00%
-25.00%
-30.00%
b1
a2
b1
a2
b1
a2
2005 - 2034
2035 - 2064
2070 - 2099
PCM B1
GFDL B1
CCSM3 B1
PCM A2
GFDL A2
CCSM3 A2

Net change in aboveground live tree carbon
stored by the end of the century (2070–2099 mean)



Why these changes?

- Increases in fire frequency and extent, drought stress and temperature changes triggering land cover changes results in decreased forest carbon for hot, dry models

- Warm, wet future climate (PCM) shows increase in forest productivity and biomass growth

Implications for forest target and inventory/monitoring

- Various approaches have been used to look at forest productivity (process, physiological, demographic) at various scales, more synthesis studies needed to develop more complete picture of carbon stock changes

- Shifting baseline problem: do you adjust expectations?

Implications for forest target and inventory/monitoring

- Toward end of century, variability between emissions scenarios becomes pronounced
- Model does not factor in management activities, e.g. that could minimize losses due to fire
- Provides opportunity to align changes in forest carbon with management opportunities that promote climate change adaptation

Acknowledgements

Co-authors: M. Rebecca Shaw, Linwood Pendleton, Belinda Morris, Greg Bratman, Dominique Bachelet, Kirk Klausmeyer, Jason MacKenzie, Dave Conklin, James Lenihan, Erik Haunreiter and Chris Daly

CEC-PIER program for support

http://www.energy.ca.gov/2009publications/CEC-500-2009-025/CEC-500-2009-025-F.PDF

The Nature Conservancy

Protecting nature. Preserving life.™